LHC NL Commissioning

A quick peek at preliminary chromaticity and RDTs results

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Outline

Setting

4 measurements were taken during the commissioning:

- 2022-04-23:
  - Confirming 2021's *beam test* data
- 2022-04-24:
  - Confirming previous day data
  - After Correcting Q'''
  - After Correcting Q''

Wide range of dpp:

- from -0.0032 to 0.0037

Observations

Overall good data for analysis.

- First measurement:
  - Q'' close to *beam test*
  - Q''' doesn't agree with *beam test*, but does with 2016
- Second Measurement:
  - Same result as above
- Third Measurement
  - Q''' well corrected
- Fourth Measurement
  - Q''' and Q'' corrected

Probable fourth and *fifth (??)* order chromaticity observed!
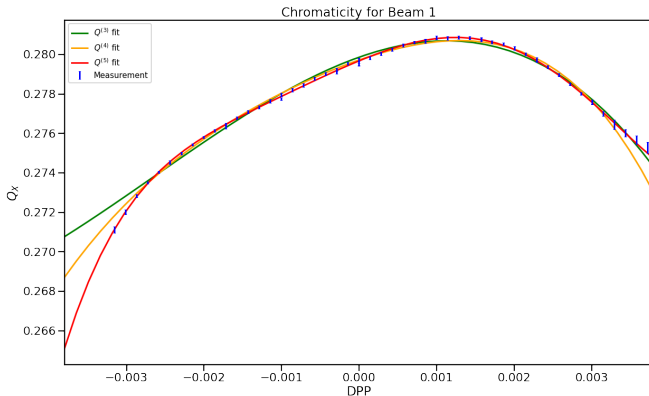
Before Correction

$$Q'' = -2.83 \cdot 10^3 \quad ; \quad Q''' = -2.59 \cdot 10^6$$
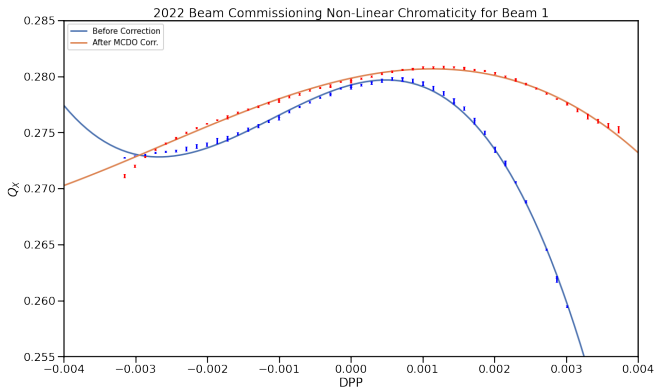

Chromaticity for Beam 1
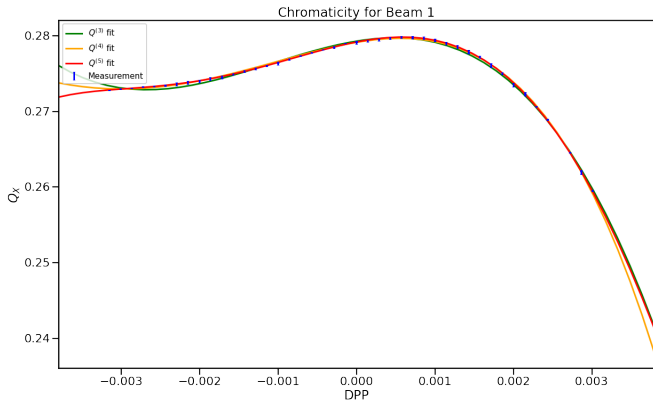
After Correction

With uniform MCDOs corrections

$$Q'' = -1.0 \cdot 10^3 \quad ; \quad Q''' = -0.38 \cdot 10^6$$

Comparison

Taking $Q^{(4)}$ and $Q^{(5)}$ into account would raise Q''' estimate

Outline

Measurement

Kicks via AC-Dipole close to the tune

- b5 resonance observed!
- Seems to get worse after Q''' corrections
  - Would indicate a non-global source of b5
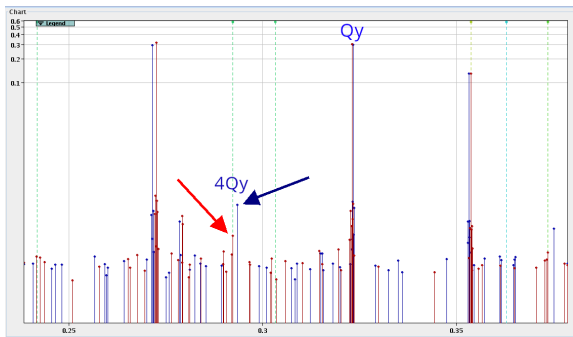
$\rightarrow$ Before Q''' correction ; $\rightarrow$ After Q''' correction

Outline

Conclusion

- Exciting data
  - Further analysis required

- super productive team thanks to OMC cake

Outline

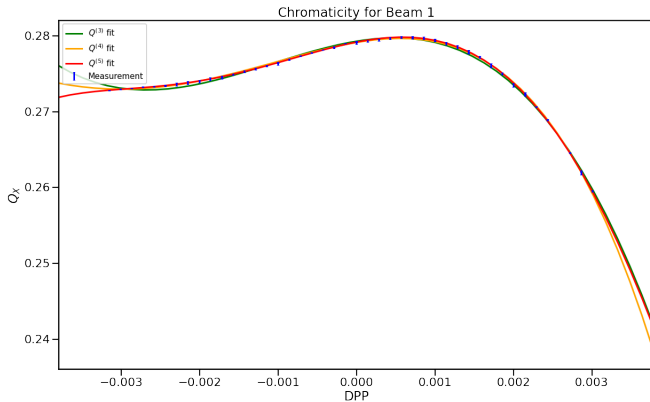# Before Correction: Beam 1 Q_x (I)

Figure: Q_x B1 before correction

Before Correction: Beam 1 Q_x (II)

$Q_0 = 0.28$

$Q' = 2.02 \times 10^0 \pm 0.0201$

$Q'' = -2.42 \times 10^3 \pm 0.0169$

$Q''' = -3.34 \times 10^6 \pm 0.042$

$Q'''' = -0.59 \times 10^9 \pm 0.0239$

$Q''''' = 1.15 \times 10^{12} \pm 0.0707$
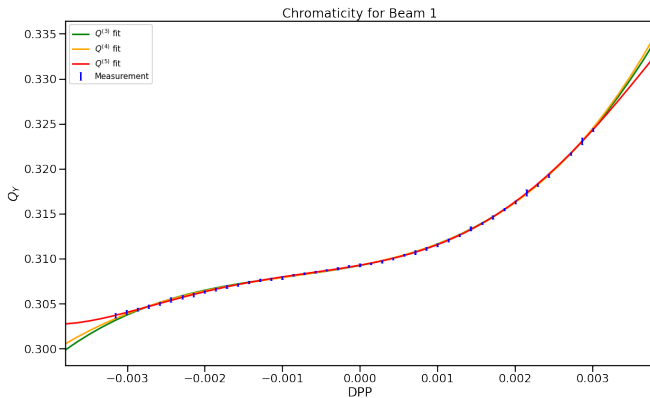
Before Correction: Beam 1 Q_y (I)

Figure: Q_y B1 before correction

Before Correction: Beam 1 Q_y (II)

Chromaticity Parameters

$Q_0 = 0.31$
$Q' = 1.53 \times 10^0 \pm 0.0189$
$Q'' = 0.97 \times 10^3 \pm 0.0192$
$Q''' = 1.62 \times 10^6 \pm 0.0508$
$Q'''' = 0.15 \times 10^9 \pm 0.0291$
$Q''''' = -0.88 \times 10^{12} \pm 0.0968$
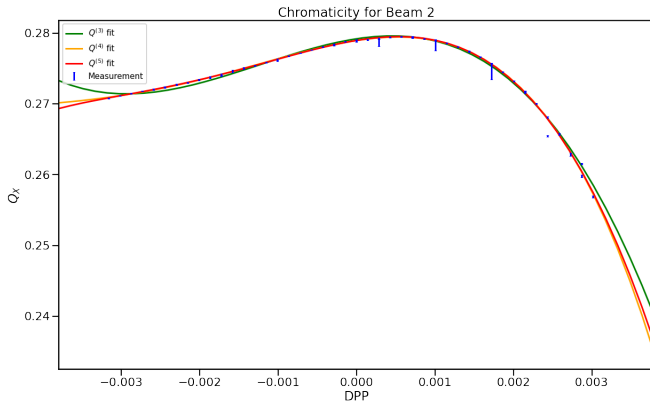
Before Correction: Beam 2 Q_x (I)

Figure: Q_x B2 before correction

Before Correction: Beam 2 Q_x (II)

Chromaticity Parameters

$Q_0 = 0.28$
$Q' = 1.82 \times 10^0 \pm 0.0552$
$Q'' = -2.52 \times 10^3 \pm 0.0576$
$Q''' = -2.9 \times 10^6 \pm 0.1345$
$Q'''' = -0.91 \times 10^9 \pm 0.0884$
$Q''''' = 0.47 \times 10^{12} \pm 0.2498$
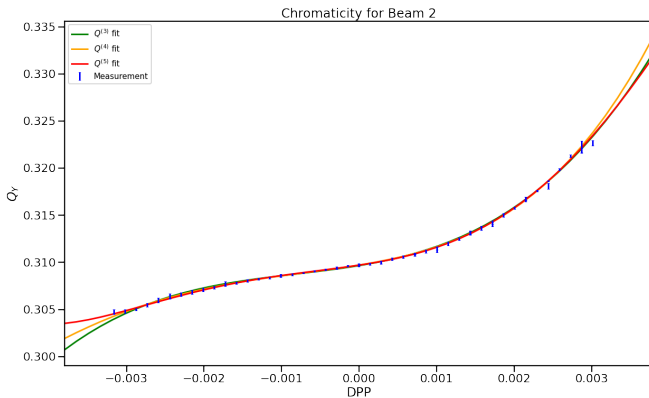
Before Correction: Beam 2 Q_y (I)

Figure: Q_y B2 before correction

Before Correction: Beam 2 Q_y (II)

Chromaticity Parameters

$Q_0 = 0.31$

$Q' = 1.24 \times 10^0 \pm 0.0237$

$Q'' = 0.76 \times 10^3 \pm 0.0262$

$Q''' = 1.52 \times 10^6 \pm 0.0658$

$Q'''' = 0.28 \times 10^9 \pm 0.0427$

$Q''''' = -0.68 \times 10^{12} \pm 0.133$
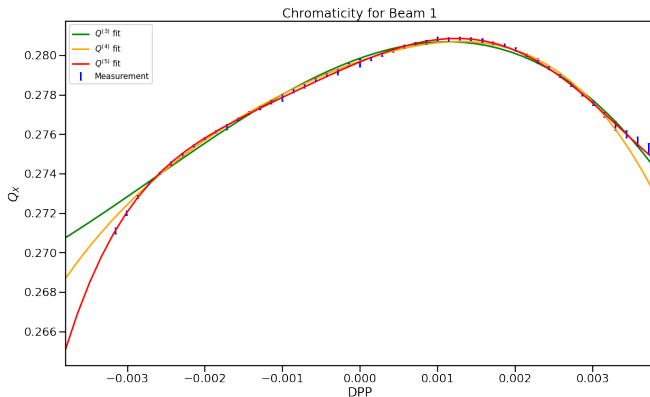
MCDO Correction: Beam 1 Q_x (I)

Figure: Q_x B1 after MCDO correction

MCDO Correction: Beam 1 Q_x (II)

Chromaticity Parameters

$Q_0 = 0.28$

$Q' = 1.62 \times 10^0 \pm 0.0129$

$Q'' = -0.61 \times 10^3 \pm 0.0125$

$Q''' = -1.0 \times 10^6 \pm 0.0274$

$Q'''' = -0.62 \times 10^9 \pm 0.0178$

$Q''''' = 1.19 \times 10^{12} \pm 0.0464$
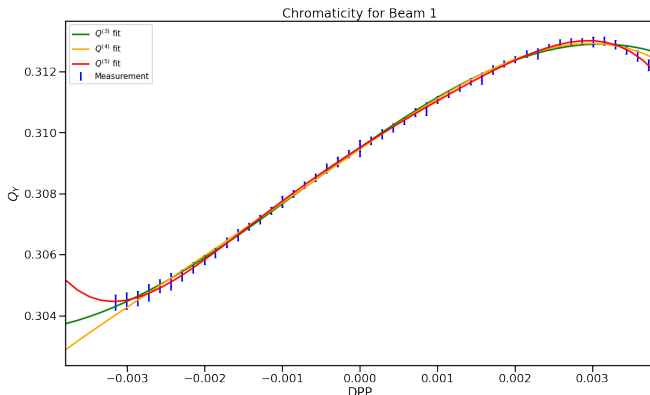
MCDO Correction: Beam 1 Q_y (I)

Figure: Q_y B1 after MCDO correction

MCDO Correction: Beam 1 Q_y (II)

Chromaticity Parameters

$Q_0 = 0.31$
$Q' = 1.63 \times 10^0 \pm 0.0095$
$Q'' = -0.23 \times 10^3 \pm 0.0118$
$Q''' = 0.13 \times 10^6 \pm 0.0196$
$Q'''' = 0.09 \times 10^9 \pm 0.0169$
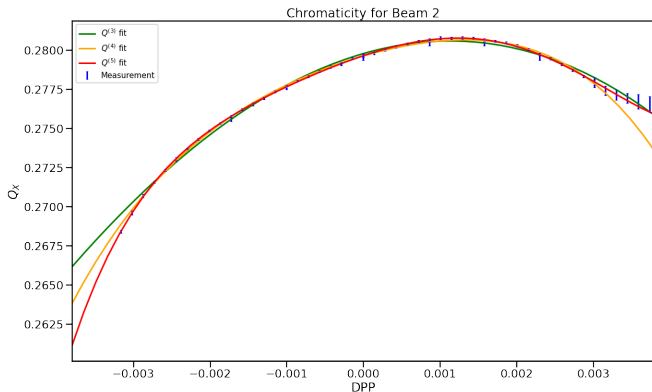$Q''''' = -0.6 \times 10^{12} \pm 0.0328$

MCDO Correction: Beam 2 Q_x (I)

Figure: Q_x B2 after MCDO correction

MCDO Correction: Beam 2 Q_x (II)

Chromaticity Parameters

$Q_0 = 0.28$

$Q' = 1.63 \times 10^0 \pm 0.0144$

$Q'' = -0.85 \times 10^3 \pm 0.0139$

$Q''' = -0.66 \times 10^6 \pm 0.0324$

$Q'''' = -0.57 \times 10^9 \pm 0.0201$

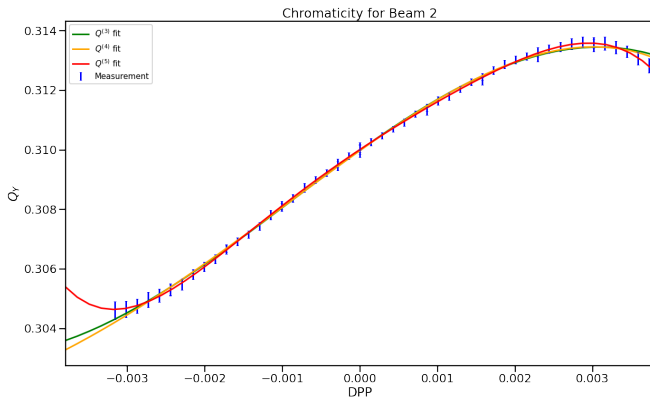$Q''''' = 1.09 \times 10^{12} \pm 0.0562$

MCDO Correction: Beam 2 Q_y (I)

Figure: Q_y B2 after MCDO correction

MCDO Correction: Beam 2 Q_y (II)

Chromaticity Parameters

$Q_0 = 0.31$
$Q' = 1.73 \times 10^0 \pm 0.0102$
$Q'' = -0.29 \times 10^3 \pm 0.0119$
$Q''' = 0.09 \times 10^6 \pm 0.0225$
$Q'''' = 0.13 \times 10^9 \pm 0.0176$
$Q''''' = -0.58 \times 10^{12} \pm 0.0378$